

# Department of Natural Sciences

*Professors:* Stuart I. Cromarty, Edward J. Dix (Chairperson), Brian K. Niece, Owen D.V. Sholes, Steven J. Theroux; *Associate Professors:* Elizabeth A. Colby Davie, David Crowley, Aisling S. Dugan, Georgi Y. Georgiev, James F. Hauri, Michele L. Lemons, Kimberly A. Schandel; *Assistant Professors:* Karolina Fucikova, Benjamin J. Knurr, Laura Marcotte, Jessica A. McCready; *Visiting Instructors:* Elissa Kraus, Anthony Sacino; *Lecturers:* Soraya Betancourt-Calle, Arthur LaPlante, Mary Lou Lombardi-Butler, Sandra Nedelescu, Hubert G. Meunier (Professor *Emeritus*).

## MISSION STATEMENT

The Department of Natural Sciences is dedicated to preparing students to live and work in a changing world by ensuring competency in the natural sciences and scientific inquiry. The department strives to provide a basic understanding of classical and contemporary scientific concepts in these areas. While developing an understanding of the scientific process and its application, the following critical skills are stressed: observation, inquiry, data collection, analysis, communication, and correlation of scientific concepts. The department prepares students for careers and professional opportunities in the sciences as well as for life-long learning in the context of a liberal arts curriculum in the Catholic tradition.

## PROGRAMS OF STUDY AND CAREER OPTIONS

The Department of Natural Sciences offers majors in Biology, Biology with a Concentration in Neuroscience and Behavior, Biotechnology and Molecular Biology, Neuroscience, Chemistry, Environmental Science, and Environmental Science with a Concentration in Environmental Policy. The Department also offers minors in Biology, Environmental Science, Chemistry, and Physics, and it co-sponsors a concentration in Physical and Occupational Therapy with the Department of Human Services and Rehabilitation Studies. Research opportunities are available at the College and at nearby institutions (e.g., University of Massachusetts Medical School and the Biotechnology Park). Students interested in teaching science in the public school system should work with a science faculty member and a member of the Education Department in planning their course of study. The Department also offers courses for non-majors.

Students who want to pursue careers in medicine, dentistry or one of the many other health professions must complete the necessary prerequisites for admission to the health profession schools of their choice. These individuals should consult their academic advisors and the Health Professions Advisor (Dr. Steven Theroux) when designing their course of study. The Health Professions Program helps students meet the admissions requirements for these professional programs. The Department has agreements with several institutions that offer degrees in the health professions. Students interested in Allopathic or Osteopathic Medicine, Podiatric Medicine, Pharmacy, Physical Therapy, Optometry, Physician Assistant Studies, Nursing, or Biotechnology should discuss these agreements with the Health Professions Advisor, Professor Steven Theroux.

The College has established a collaborative program of study in Engineering with the University of Notre Dame. Students spend three years at Assumption College completing foundational courses in math and science before transferring to Notre Dame to complete engineering studies. Interested students should contact Professor Jimmy Hauri, Director of the 3:2 Engineering Program.

The College also has agreements with several graduate schools. In conjunction with Duke University we offer combined B.A. and Master's degree programs in Environmental Science Management and Forestry Management. There are several options for students interested in the legal profession, especially those interested in practicing environmental law or intellectual property law. Science students interested in the learning more about all of these programs should see Professor Steven Theroux.

The Department offers a post-graduate program for those who have a bachelor's degree in an area other than Biology and who are interested in pursuing admission to a health professions program (e.g., medicine, dentistry, pharmacy, etc.) Details about this certificate program can be obtained from the Health Professions Advisor, Dr. Steven Theroux.

Students who graduate with an undergraduate degree in science can pursue employment in industry, government, or in an educational setting. Some of our students pursue graduate studies in science, one of the health professions, business or law.

Upon the completion of the appropriate graduate program our students can pursue research careers in environmental management, or in the biotechnology, pharmaceutical and chemical industries. They can also develop careers in elementary, secondary and higher education, or in the health professions, business management, government, or legal profession.

## MAJOR IN BIOTECHNOLOGY AND MOLECULAR BIOLOGY (17)

Biotechnology has developed around the study of living things at the molecular level. The chemistry of genetics has found applications in medicine and industry. Techniques of molecular genetics have allowed dramatic advances in our understanding of developmental biology, physiology, immunology, and evolution. This major provides a balanced foundation in biology, plus an introduction to the theory and methods of biotechnology and molecular biology. Students in the major are encouraged to do internships at biotechnology laboratories in the Worcester area. When they graduate, students can pursue graduate study in the biological sciences or in the health sciences. The major is also excellent preparation for a teaching career or employment in a biotechnology-based field.

## REQUIRED COURSES (14)

Biotechnology and Molecular Biology majors should take CHE 131 and BIO 160 in their first semester.

BIO 160	Concepts in Biology
BIO 210	Genetics
BIO 250	Microbiology
BIO 340	Molecular and Cellular Biology
BIO 440	Biotechnology: Theory and Practice
CHE 131–132	General Chemistry I and II (Note: MAT 114 is a pre-requisite for CHE 132)
CHE 201–202	Organic Chemistry I and II
CHE 414	Biochemistry
MAT 114	Elementary Functions, or higher if placed higher
PHY 201–202	General Physics I and II
PHI 151	Ethics and the Good Life

## ELECTIVES (3)

Three additional electives in Biology from level 200 or above. A maximum of two of these electives can be selected from internships or BIO 490 or 491. Additional internship or independent study credits will count toward degree requirements but will not count toward the major in Biology. PHI 262 Biomedical Ethics is strongly recommended, but not required.

## STUDENT RESEARCH—SUMMER OPPORTUNITIES

Department faculty members oversee research programs on campus that engage upper-level students in the projects associated with their research interests. Summer research positions that provide a stipend are available on a competitive basis. Assumption students have been accepted into prestigious summer research programs at major research institutions around the country. The sponsoring institutions for this research include the National Science Foundation, the National Institutes of Health, and the American Cancer Society.

## PREPARATION FOR TEACHING SCIENCE AT THE SECONDARY LEVEL

Students interested in seeking certification to teach high school biology or chemistry should consider a Major in Biology or Chemistry and a Major in Education, Secondary License. Application to the Education Major must be made by April 30 of the sophomore year. Please see a complete description of procedures and policies in the Department of Education section of the catalog. A student should carefully plan a course of study in conjunction with advisors in both departments (Education and Natural Sciences).

### Biology – Field of Knowledge Competencies:

BIO 160	Concepts in Biology
BIO 210	Genetics
BIO 230	Botany
BIO 220	Zoology

BIO 240	Human Anatomy
BIO 370	General Physiology
BIO 360	Ecology
CHE 131–132	General Chemistry I and II

**Chemistry – Field of Knowledge Competencies:**

CHE 131–132	General Chemistry I and II
CHE 201–202	Organic Chemistry I and II
CHE 316	Inorganic Chemistry
CHE 315	Analytical Chemistry
CHE 311–312	Physical Chemistry I and II
PHY 201–202	Physics I and II
MAT 117–118	Calculus I and II
MAT 131–132	Honors Calculus I and II

**OR**

## PRE-MEDICAL/PRE-DENTAL

As a liberal arts college, Assumption offers students the knowledge necessary for entrance to and success in medical and/or dental school. Most students interested in pursuing a career in Medicine or Dentistry major in Biology, however, it is possible to choose other majors and still prepare for such a career. Although there is no universal standard for medical school admissions, most school requirements would be fulfilled by inclusion of the following courses:

BIO 160 Concepts in Biology

One from the following three Biology courses:

BIO 210	Genetics
BIO 240	Human Anatomy
BIO 340	Molecular and Cellular Biology
CHE 131–132	General Chemistry I and II (Note: MAT114 is a pre-requisite for CHE132)
CHE 201–202	Organic Chemistry I and II
PHY 201–202	General Physics I and II
ENG 130	English Composition
LTE 140	Introduction to Literature

Additional courses that are usually highly recommended include:

- CHE 414 Biochemistry
- MAT 117 Calculus I or MAT131 Honors Calculus I
- ECO 115 or PSY 224 Statistics
- Courses in Psychology, and Computer Science
- Additional courses in Biology, Chemistry, and Mathematics are helpful.

Note these courses reflect a **suggested** course load. Students should contact their desired schools and Dr. Steven Theroux before committing to a plan of study.

## HEALTH PROFESSIONS PROGRAM

The Health Professions Program is designed to help students enter graduate school in one of the health professions (Medicine, Dentistry, Physical Therapy, Occupational Therapy, Physician’s Assistant, etc.). The program focuses on preparing the student to earn good grades and strong scores on the admissions test and graduate school interview. Those who complete the program requirements will have the fact that they did so listed on their transcript. All students interested in a health profession should consult with their advisors and Dr. Steven Theroux, Chairperson of the Health Sciences Committee, at the beginning of their undergraduate careers.

To complete the Health Professions Program, the student must:

- Successfully finish a major in Biology; Biology with a Concentration in Neuroscience and Behavior; Biotechnology and Molecular Biology; Chemistry; Psychology; Psychology with a Concentration in Neuroscience of Human Behavior; or Human Services and Rehabilitation Studies
- Complete the required coursework with a cumulative GPA of 3.0 or better overall and a GPA of 3.0 or better in the major
- Complete the “Social, Economic and Ethical Issues in the Health Professions” course
- submit at least one list of prerequisite courses required for a specific health-related graduate program to which he or she intends to apply
- Submit a statement indicating that the prerequisite courses required for admission to a particular health professions graduate program were successfully completed
- Present evidence from Kaplan that he or she successfully completed a Kaplan Test Preparation Course (e.g., MCAT, DAT, OAT, VCAT, PCAT, GRE, etc.). (The exact course that the student completes will vary depending on the graduate program the individual hopes to enter.)
- Present evidence that he or she took a graduate admissions test (e.g., MCAT, DAT, GRE, etc.) and scored in the top 50% of those taking the test in that year. Kaplan preparation courses are offered on campus at reduced rates. Financial aid is available.

Students who plan to pursue a graduate degree in a health profession should be aware of the timetable in which to fulfill their requirements, which include admissions exams and letters of reference from the Health Sciences Committee. Students should be prepared for entrance exams in their junior year and request a letter of reference at that time. Students must contact Dr. Theroux at least two weeks before the scheduled Committee meeting times in the second week of October, the second week of February, and the second week of May. The letters will usually be ready within four to five weeks of the meeting.

## ARTICULATION AGREEMENTS IN THE SCIENCE AND HEALTH PROFESSIONS

Assumption College holds a wide range of agreements with graduate institutions in the health sciences. For a complete list, including agreements with law schools and Notre Dame’s College of Engineering, see the “Cooperative Programs of Study and Agreements” section of the catalog and contact the Health Professions Advisor, Prof. Steven Theroux, [stheroux@assumption.edu](mailto:stheroux@assumption.edu).

### Massachusetts College of Pharmacy and Health Sciences B.A./Bachelor of Science in Nursing (B.S.N.)

The Massachusetts College of Pharmacy and Health Sciences (MCPHS) has agreed to provide at least three seats at their Manchester, NH campus and three seats in their Worcester, MA campus for qualified Assumption students who want to earn a Bachelor of Science in Nursing. To qualify for one of the limited number of guaranteed seats, Assumption students must complete the specified prerequisites with a grade of C or better (with no repeats), earn a cumulative GPA of 3.2 in the required prerequisites, and obtain a GPA of 3.2 or higher. Please see the Health Professions Advisor for additional details and requirements.

### Massachusetts College of Pharmacy and Health Sciences B.A./Doctor of Pharmacy (Pharm.D.)

The Massachusetts College of Pharmacy and Health Sciences (MCPHS) has agreed to provide two seats at their Manchester, MA campus and five seats at their Worcester, MA campus for qualified Assumption students who want to enter an accelerated doctoral program in pharmacy. To qualify for admission into this 34-month course of study, Assumption students must complete the required prerequisites with a grade of C or better (no repeats). They must also have a GPA of 3.4 in the required prerequisites and an overall GPA of 3.4.

### Massachusetts College of Pharmacy and Health Sciences B.A./Master of Science in Physician Assistant Studies (M.S.P.A.S.)

The Massachusetts College of Pharmacy and Health Sciences (MCPHS) has agreed to provide at least one seat at their Manchester, MA campus and one seat at their Worcester, MA campus for qualified Assumption students who want to earn a

master's degree in Physician Assistant Studies. This is a 24-month program, and to qualify for one of the limited seats, Assumption students must complete the prerequisites with a grade of C or better (with no repeats). They must also have a GPA of 3.4 in the required prerequisites, an overall GPA of 3.4, and they must pass an interview at MCPHS.

## **New York Chiropractic College (NYCC) B.A./Doctor of Chiropractic (D.C.)**

There are two options at NYCC for Assumption students interested in pursuing a doctorate in Chiropractic.

**Traditional Doctoral Program (D.C.)** Five seats are available at NYCC each year for qualified Assumption students who want to enter a doctoral program in Chiropractic.

**Accelerated Doctoral Program (D.C.)** Qualified Assumption students are also eligible to enter an accelerated program of study at NYCC. This course of study allows qualified students to complete a doctorate in chiropractic in six years of study instead of the typical seven.

## **Barry University B.A./Doctor of Podiatric Medicine (D.P.M.)**

Assumption College and Barry University School of Podiatric Medicine have agreed to cooperate in providing an accelerated, seven-year curriculum of undergraduate and professional education leading to the Bachelor of Arts degree with a major in Biology from Assumption College and the Doctor of Podiatric Medicine degree from Barry University School of Podiatric Medicine. Upon successful completion of their first year at Barry University College of Podiatric Medicine, individuals in this program are eligible to graduate with a bachelor's degree from Assumption College. Admission into the School of Podiatric Medicine is not guaranteed.

## **New England College of Optometry B.A./Doctor of Optometry (O.D.)**

Assumption College and the New England School of Optometry have agreed to cooperate in providing an accelerated, seven-year curriculum of undergraduate and professional education leading to the Bachelor of Arts degree with a Major in Biology from Assumption College, and the Doctor of Optometry degree from the New England College of Optometry. The program consists of a three-year curriculum at Assumption College followed by a four-year curriculum in optometry at the New England School of Optometry. Upon successful completion of their first year at the New College of Optometry, individuals in this program are eligible to graduate with a bachelor's degree from Assumption College. Admission into the School of Optometry is not guaranteed.

## **Massachusetts College of Pharmacy and Health Sciences B.A./Doctor of Optometry (O.D.)**

The Massachusetts College of Pharmacy and Health Sciences (MCPHS) has agreed to provide five seats at their Worcester, MA campus for qualified Assumption students who want to earn a Doctorate in Optometry. To qualify for admission, students must complete the required prerequisites with a grade of C or better (no repeats). They must also have a GPA of 3.2 in the required prerequisites and an overall GPA of 3.2, and they must pass an interview at MCPHS.

## **Regis College M.S.in Molecular Imaging and Therapeutics**

Regis College has reserved two seats for Assumption students who want to enter the Molecular Imaging and Therapeutics M.S. program. To be eligible, Assumption students must complete the prerequisite courses, and they must have a minimal GPA of 3.0. Eligible students receive waivers for the GRE/MAT requirement and the application fee. The top two eligible candidates are also given preferred admission without the competition of the rest of the applicant pool. Prior to starting the program the accepted student must earn a B.A. at Assumption College. For more information, see the Health Professions Advisor, Prof. Steven Theroux.

## **Northeastern University Graduate School**

Northeastern University will reserve space for two qualified Assumption College students in its Master of Science in Biotechnology program. The minimum requirements for acceptance include a GPA of 3.2, satisfactory completion of all prerequisites, and a completed application. The GRE and application fee will be waived for these students. In addition, Northeastern University will waive the application fee and the GRE requirement for qualified Assumption College students who are interested in pursuing graduate studies in Biotechnology, Pharmaceutical Science, Physician Assistant Studies, Health

Informatics, Public Health, Exercise Physiology and School Counseling. The minimal requirements for these waivers include a GPA of 3.2.

## **Duke University Marine Sciences Education Consortium (MSEC)**

Assumption students are eligible to study at Duke University's Marine Laboratory in Beaufort, North Carolina. The Duke program offers an opportunity for intensive study in marine science and marine ecology. In addition, Assumption students may participate in the MSEC's study abroad programs which include sites in Singapore, Trinidad, Hawaii, Panama and France. This program should be of particular interest to Environmental Science majors and minors and to those who seek a science-intense study abroad opportunity.

## **Duke University 3:2 Program in Environmental Science Management and Forestry Management**

Students interested in pursuing a master's degree from Duke University in Environmental Science Management (MEM) or Forestry Management (FM) can complete their general education requirements, their major requirements, and their application for admission to the Duke graduate school in three years. If accepted into the Duke professional master's degree program, the student is eligible to receive his or her Assumption College undergraduate degree upon the successful completion of their first year of graduate studies at Duke. At the end of the second year of graduate study, the student is eligible to receive the MEM or the FM from the Nicholas School at Duke University. The Duke agreement does not guarantee that Assumption College students will be accepted into the graduate program, and admission is competitive.

## **The University of Notre Dame B.S. in Engineering**

Assumption College has established an agreement with the University of Notre Dame College of Engineering that allows qualified Assumption students to earn a B.A. in Chemistry, Environmental Science, Mathematics or Computer Science from Assumption College and a B.S. in one of several fields of Engineering from the University of Notre Dame. This program is a 3:2 program, which means students spend three years studying at Assumption College followed by two years at Notre Dame. Contact Professor Joseph Alfano for more information.

## **Washington University at St. Louis B.S. in Engineering**

Assumption College and Washington University offer a 3:2 engineering degree that leads to a B.A. from Assumption and a B.S. in one of several fields of engineering. This program is very similar to the University of Notre Dame's 3:2 degree program described above. To participate a student must have a 3.25 GPA, and admission to Washington University is not guaranteed. Assumption College and Washington University also offer a 3:3 option for those seeking to earn a Master's Degree in Engineering. Students in this course of study spend three years at Assumption College and three years at Washington University, and upon completion they are awarded a B.A. from Assumption College and a Masters in Engineering from Washington University. Participation in the 3:3 program also requires the student to maintain a 3.25 GPA while at Assumption, and admission to Washington University is not guaranteed. Washington University has a highly-regarded and nationally ranked engineering program, and qualified students who enter the 3:2 or 3:3 programs can choose to study Biomedical Engineering, Chemical Engineering, Computer Engineering, Electrical Engineering, Mechanical Engineering or Systems Science and Engineering. Students entering the 3:2 or 3:3 programs are eligible for financial aid from Assumption College and Washington University. For more information contact Prof. James Hauri at 508 767-7359.

## **POST-BACCALAUREATE CERTIFICATE PROGRAM**

### **IN PREREQUISITES FOR PROFESSIONAL SCHOOLS IN HEALTH FIELDS**

This program is designed for individuals who hold Bachelor's degrees, who have not previously made application to Professional Schools in the Health Professions, and who are seeking to complete prerequisites before making an application. Participants will have "non-matriculating" status, and will be charged tuition and fees at the rate listed in the catalog. All courses will be taken with undergraduate students. Programs will be planned in consultation with the College's Advisor for the Health Professions, Dr. Steven Theroux. A participant must complete at least four courses with three different faculty members in the Department of Natural Sciences at Assumption in order to earn a certificate and a recommendation from the Recommendation Committee for the Health Professions. Applicants need to submit a completed application form, available from Dr. Steven

Theroux, a written statement describing their motivation for the chosen health career, and official undergraduate transcripts. To be applicants get a seat in the courses that they need to take, these applications should be completed by the end of February prior to their Fall attendance. Completion of this certificate does not guarantee admission to a professional school.

## Course Descriptions

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### BIOLOGY (BIO)

#### **BIO 102 HUMAN BIOLOGY IN HEALTH AND DISEASE**

A course for non-science majors that focuses on selected functional systems of the body, the organs that compose them, and the interactions among them. Special attention will be given to disease processes. In these systems laboratory work (one three-hour session per week) will include studies of physiological concepts at the cellular and systems levels. This course is especially designed for students majoring in Social and Rehabilitation Services or Psychology, or students seeking background for courses in Anthropology and other social sciences. Lab Fee: \$400.00. This course fulfills the Core Curriculum requirement for a science with a lab. (Fall, Spring)

*Staff/Four credits*

#### **BIO 105 HUMAN HEREDITY**

This course presents an introduction to the principles of human genetics. Major topics covered include cell division and the distribution of genetic material, embryonic development and the role of teratogens; Mendel's experiments, inheritance patterns in human families; the interaction of genes and the environment; the structure and function of DNA; personal genomics; and genetic technologies. An historical approach is used and most genetic principles are introduced by examples from human medical genetics. Two or three integrated lecture-laboratory sessions per week. Lab fee: \$200 starting in 2018-19. This course fulfills the Core Curriculum science requirement for the Class of 2020 and after. (Fall, Spring)

*Staff/Three credits.*

#### **BIO 110 NUTRITION**

This course will explore the basic principles of human nutrition. Topics to be covered include nutrient classes, nutritional guidelines, nutrition-related diseases and disparities in access to healthy foods. This course will also cover controversial topics in nutrition such as GMOs and fad dieting. This will be an interactive course that will require students to use the scientific method and will include in-class research, data collection, presentations and discussions. The course will consist of two one-hour-and-fifteen-minute integrated lecture/laboratory sessions each week. Lab fee: \$200 starting in 2018-19. This course fulfills the core curriculum science requirement for the Class of 2020 and after.

*Staff/Three credits*

#### **BIO 115 MATTERS AND MYSTERIES OF YOUR BRAIN**

The brain is the most complex and least understood organ in our bodies. It is fascinating to consider that the brain is required for a vast array of functions including learning and memory, motor movement, and perception of our environment. The brain's vital role in our daily life is indisputable, yet we do not fully understand the fundamental underpinnings of brain function. For this reason, the brain is referred to as the last frontier of science. In this course, student-driven approaches will be used to explore what is known and what is not yet fully understood about brain function through the use of case studies of humans suffering from brain injury, hypothesis-driven experimentation, and critical examination of recent science findings as described by the media. Students will refine their practice of the scientific method while enhancing critical thinking skills. Lab fee: \$200 starting in 2018-19. This course fulfills the Core curriculum science requirement for the Class of 2020 and after.

*Staff/Three credits*

#### **BIO 140 INQUIRY BIOLOGY FOR EDUCATORS**

In this course, students learn fundamental concepts and models associated with three major subdisciplines of biology – genetics, ecology, and evolution. The course heavily emphasizes the use of open-ended, problem-solving methods of teaching and learning to help students develop their own functional understanding of the major concepts. A significant part of students' problem-solving work involves the use of computer technology, including the use of concept mapping and computer simulations to facilitate concept development. The course is intended for students planning on pursuing a career in elementary or middle school education. As such, particular attention is given to understanding common misconceptions that children have concerning learning about biological

phenomena and considering the ramifications of these misconceptions for the development of effective classroom instruction. At least twice during the term, students will be expected to teach “mini” lessons in the biological sciences to visiting elementary school children. The course meets twice weekly in a 3-hour lab session. This course fulfills the Core Curriculum requirement for a science with a lab. (Fall, Spring)

Howe/Four credits

### **BIO 160 CONCEPTS IN BIOLOGY**

An introductory course required of all science majors that emphasizes major concepts in biological science: structure and function, homeostasis, energetics, perpetuation, and evolution of living organisms. The laboratory will introduce students to the techniques and approaches used in biology. Three lectures and one laboratory period each week. Should be taken by intended science majors in the first year. Lab Fee: \$400.00. This course fulfills the Core Curriculum requirement for a science with a lab. (Fall, Spring)

Staff/Four credits

### **BIO 210 GENETICS**

A brief survey of Mendelian and cytological genetics with most emphasis placed on recent advances in molecular genetics. Replication, translation, and transcription of the genetic material receive detailed study. Three lectures and one laboratory per week. Prerequisite: BIO 160 and a course in Biology or Chemistry. Should be taken before the Junior year. Lab Fee: \$400.00 (Fall, Spring)

Crowley, Kraus, Theroux/Four credits

### **BIO 220 INVERTEBRATE ZOOLOGY**

A survey of invertebrate animals from protozoans through invertebrate chordates, emphasizing their functional organization, modes of reproduction, ecological roles, and evolutionary relationships. In the laboratory, we will examine representative living and preserved specimens, concentrating on their structure and behavior. Three lectures and one laboratory or field trip each week. Prerequisite: BIO 160 or equivalent. Lab Fee: \$400.00. (Spring)

Sholes/Four credits

### **BIO 230 PLANT BIOLOGY**

This course provides an introduction to the biology of plants. Among the topics considered are the role of plants in the biosphere, plant form and function, and the evolution of plants. In the laboratory, students examine representatives of the major groups of plants and learn the fundamentals of plant tissue culture techniques in order to study plant growth and development. Field work includes trips to a variety of local habitats. Three lectures and one laboratory or field trip each week. Prerequisite: BIO 160 or equivalent. Lab Fee: \$400.00. (Fall, even-numbered years)

Sholes/Four credits

### **BIO 240 HUMAN ANATOMY**

Anatomy is the study of the structure of organisms. In this course we will study human anatomy in four regions: (i) back, (ii) upper and lower limbs, (iii) thorax, abdomen and pelvis, and (iv) head and neck. We will focus on anatomy of the human body and emphasize how structure affects function. Major topics covered in each region include muscles, bones, blood vessels and nerves. This course will consist of three one-hour lectures and one three-hour laboratory each week. Prerequisite: BIO 160 or equivalent. Lab Fee \$400 (Fall)

McCready/Four credits

### **BIO 250 MICROBIOLOGY**

Microorganisms, especially bacteria and viruses, are studied with respect to their morphological characteristics, growth and metabolism, genetics and environmental significance. The role of microorganisms as pathogens and the control of microorganisms are also considered. Laboratory techniques include sterilization, isolation, and culturing. Three lectures and one laboratory per week. Prerequisite: BIO 210. Lab Fee: \$400.00. (Fall)

Dugan/Four credits

### **BIO260 BIOINFORMATICS**

Bioinformatics is the umbrella term for a wide range of methods and tools used to analyze large and complex biological data sets, especially DNA and RNA sequence data. This course introduces students to broadly applicable bioinformatic methods. Students will learn to access and use information from public databases, align homologous sequences, construct and interpret phylogenetic trees, and extract information from genomes using a variety of computational tools, including the use of basic



command line interface. Relevant primary literature will be analyzed and discussed. The laboratory portion of the course is dedicated to practice with the analysis tools introduced in lectures, and to student projects. Students will work in groups to explore real data sets, select and apply suitable bioinformatic methods, interpret analysis results in the context of published works, and present their findings to the class. This course fulfills the Core Curriculum science requirement, and counts as an elective towards the Biology, Biotechnology, and Data Analytics majors.

#### **BIO 275 SPECIAL TOPICS IN BIOLOGY**

This special topics course will explore an area of biology using the literature, and if appropriate, a cross-disciplinary approach. The course will allow the students and faculty an opportunity to investigate areas of biology that are not part of the regular curriculum.

*Staff/Three credits*

#### **BIO 280 SENSORY SYSTEMS**

This course provides an understanding of how we see, hear, smell, taste and feel sensations. Students will gain an understanding of the physiological and cellular mechanisms that allow us to receive sensory information and how it is processed by the relevant areas of the brain. Specifically, the course will address 1) how external stimuli impact our central neural pathways and give rise to recognition and perception; 2) the nature and extent of sensory systems from the periphery to CNS, with emphasis on the higher mammalian systems, but including appropriate comparative animal models, will be included for greater clarity and 3) an analysis of the basic elements of the cognitive processes involved in sensory interpretation and reaction. Three lectures and one three-hour laboratory each week. Prerequisites: BIO 160 Concepts in Biology, BIO 210 Genetics, and PSY 251 Introduction to Brain and Behavior **or** BIO 370 General Physiology. (Spring)

*Cromarty/Four credits*

#### **BIO 291 INTERNSHIP IN BIOLOGY**

Directed study within an internship program. The student will be expected to keep a journal detailing the internship. The student will also be expected to write a paper, usually approximately 10 pages in length, summarizing an area related to the internship experience. An evaluation by the on-site supervisor will be considered when determining the grade. The student will be required to have a G.P.A. of 3.0 to enroll.

*Staff/ Three credits*

#### **BIO 310 ANIMAL BEHAVIOR**

This course will initially approach the study of animal behavior from the physiological perspective: the neural basis of behavior (the nervous circuits responsible for sensory input and integration and motor output) will be studied in some detail. Subsequently, the emphasis will shift to the contribution of ecological, developmental, and evolutionary forces to shaping the ultimate behavior output. Three lectures and one three-hour laboratory each week. Lab fee \$400.00. Prerequisite: BIO 220 or BIO 240. (Fall)

*Cromarty/Four credits*

#### **BIO 320 ORGANIC EVOLUTION**

This course is an introduction to genetic changes in populations over time and to the models and evidence we use to identify and explain those changes. Topics include: influence of the environment, genotype-phenotype connections, Hardy-Weinberg equilibrium, genetic variation, genetic drift, in-breeding, natural selection, gene flow, speciation, phylogeny, macro-evolutionary trends, and the fossil record. Prerequisite: BIO 210. (Spring)

*Sholes/Three credits*

#### **BIO 340 MOLECULAR AND CELLULAR BIOLOGY**

This course focuses on the structure and function of the eukaryotic cell. The role of cellular membranes in basic physiological processes is discussed in detail. The physiological roles of the extracellular matrix, the cytoskeleton, and various subcellular structures are also addressed. Finally, the student will be introduced to the processes that govern cellular division and cellular evolution. When possible, the course topics are related to the development of various human maladies, such as cancer and AIDS. The laboratory exposes the students to several classical techniques used in cell biology and to a number of modern methods used by protein chemists and molecular biologists. Prerequisite: BIO 210 or permission of the instructor. Lab Fee: \$400.00. (Spring)

*Crowley, McCready, Pickering/Four credits*

### **BIO 350 MARINE MAMMALS: BIOLOGY AND CONSERVATION**

This course is designed to familiarize students with the biology and natural history of marine mammals. Emphasis is placed on whales, dolphins, and seals of the western North Atlantic, but species from all over the world will be discussed. Topics to be considered include evolution, anatomy, behavior, field identification, the history of whaling, and contemporary conservation problems. Hands-on activities include one evening laboratory work (harbor porpoise or seal dissection) and marine mammal survey on Massachusetts Bay. Prerequisites: BIO 160 and two additional biology course. (Fall)

Marine Studies Consortium/*Three credits*

### **BIO 360 ECOLOGY**

In this course, students interpret published data, critique some original papers, and participate in class discussion on the following topics: limits on species distributions, demography, population growth and regulation, interactions of species, energy flow, nutrient cycling, community dynamics, succession, and patterns of species diversity. In laboratory, students participate in class exercises, and design, perform, and report their own group field projects. Three lectures and one three-hour laboratory per week. Lab Fee: \$400.00. Prerequisite: Two Biology courses or permission of instructor. (Fall, odd-numbered years)

Sholes/*Four credits*

### **BIO 370 GENERAL PHYSIOLOGY**

Human and animal physiology, with a comparative approach to the study of muscle contraction; blood circulation and respiration; metabolic and temperature controls; digestion and excretion; and nervous, sensory, and endocrine functions. The laboratory exercises focus on the investigation of basic concepts of animal and human physiology at the cellular and systems levels. Three lectures and one three-hour laboratory period each week. Lab Fee: \$400.00. Prerequisites: BIO 240 or permission of instructor. (Spring)

Cromarty, Lemons/*Four credits*

### **BIO 375 MILESTONES IN NEUROSCIENCE**

This course explores select landmark advances within the field of neuroscience through critical examination of the primary literature. Using primary articles as a tool, students gain a deeper understanding of essential neurobiological themes such as neuroplasticity, neural degeneration and neural induction. Classic and current articles are thoroughly dissected, providing opportunities to gain a historical appreciation of advances in the field, to learn biological underpinnings of neuroscience research techniques, practice evaluation of research design, and determine if data fully supports conclusions. Students gain a deeper understanding of highlighted milestone advances in neurobiology, and will describe the implications of these findings at the time of publication. Prerequisites: BIO 160, BIO 210, BIO 340, and PSY 251 **OR** BIO 370; or by permission of the instructor. (Spring)

Lemons/*Three credits*

### **BIO 380 THE BIOLOGY OF CANCER**

This course will explore the biology of cancer. Beginning with an examination of the personal, social and economic consequences of this disease, it will move to a focus on the cellular and molecular biology of cancer. Specially, it will study the nature of cancer, the role of viruses in cancer, cellular oncogenes, cellular signaling mechanisms, tumor suppressor genes, and the maintenance of genomic integrity. Other topics to be examined include: the cell cycle, apoptosis, cellular immortalization, tumorigenesis, angiogenesis and metastasis. Finally, this course will examine how modern molecular medicine is being used to treat cancer. Prerequisites: BIO 160, BIO 210, BIO 340. (Fall)

Theroux/*Three credits*.

### **BIO 390 EXERCISE PHYSIOLOGY**

This advanced course is designed to provide students with applied knowledge relative to the human's physiologic responses to acute and chronic exercise stress. Students' basic knowledge of neuromuscular physiology, energy metabolism, cardiovascular and respiratory physiology will be honed to focus on human exercise response, with the focus of the course being on applications to exercise training and programming, sport, nutrition, youth, aging, and disease. Laboratory exercises will enable practical skills to be gained in measuring and testing for physiological markers of human readiness and response to exercise. Prerequisites: BIO 240 and BIO 370. Lab Fee: \$400.00.

Caron/*Four credit*

### **BIO 410 INTRODUCTORY IMMUNOLOGY**

The focus of this course is the biology of the immune response. Topics include immunoglobulin structure, the generation of antibody diversity, and the cellular basis of the immune response. Disorders of the immune system, such as allergies,

autoimmune diseases, and AIDS are also considered. In the laboratory, students learn tissue culture and such immunologic techniques as SDS gel electrophoresis; Western blotting; ELISA fluorescent antibody staining; isolation and study of B cells, T cells and macrophages; mixed lymphocyte reactions; and hemolytic plaque assays. Three lectures and one laboratory per week. Lab Fee: \$400.00. Prerequisites: BIO 340, CHE 131–132. (Spring, even-numbered years)

Dugan/*Four credits*

#### **BIO 415 PRINCIPLES OF NEUROSCIENCE**

This course introduces students to the rapidly growing field of neuroscience, which is the study of the nervous system. Our nervous system shapes our every thought, emotion and sensation. Students will gain an understanding of the underlying neural basis of how we perceive the world. This course begins with an anatomical approach and then integrates physiological, cellular, molecular and functional approaches. Topics range from how cells in the brain communicate with one another, to current diagnostic and research technology, to the biological basis of movement, and includes the study of disease and injury to the brain, such as Alzheimer's disease, Parkinson's disease and stroke. Three lectures and one three-hour laboratory each week. Lab Fee \$400. Prerequisites: BIO 370 or BIO 340 or permission of the instructor. (Fall)

Lemons/*Four credits*

#### **BIO 420 DEVELOPMENTAL BIOLOGY**

This course covers the principles and concepts of growth, morphogenesis, and differentiation in developing animals. We will discuss the major features of embryonic development from fertilization through organogenesis. Particular attention is given to how the regulation of specific genes contributes to development of an embryo. The lab will allow the student to explore techniques used by developmental biologists. Students will also have the opportunity to develop an independent project. Prerequisite BIO 340 or permission of the instructor. (Spring, odd-numbered years)

Lemons/*Four credits*

#### **BIO 430 COMPARATIVE PHYSIOLOGY**

This course combines a brief review of fundamental principles of animal physiology with an in-depth discussion of how these principles are modified and shaped by environmental and ecological pressures. The functional significance of physiological adaptation to an animal's environment is emphasized by describing various mechanisms of regulation of physiological variables (temperature, metabolism, oxygen consumption, water retention, circadian rhythms) in extremely different environmental conditions. Three lectures and one three-hour laboratory each week. Prerequisite: BIO 370 or permission of instructor. Lab fee: \$400.00. (Fall, alternate years)

Cromarty/*Four credits*

#### **BIO 440 BIOTECHNOLOGY IN THEORY AND PRACTICE**

This course integrates the disciplines of cellular biology, molecular biology, and protein chemistry through a series of related experiments. The course will expose students to: 1) recent journal articles within the scientific literature; 2) selected methods, techniques, and instruments used in biotechnology; and 3) strategies that can be employed to solve interesting biological problems. The laboratory experience will introduce the student to DNA amplification by the polymerase chain reaction; oligonucleotide-directed site specific mutagenesis; gel electrophoresis; isolation of protein, DNA and RNA; gene cloning; DNA sequencing; cell culture; gene expression in mammalian cell lines; and Southern hybridization analysis. Class meets six hours per week for lecture, laboratory, and discussion. Lab Fee: \$400.00. Prerequisites: CHE 202 and BIO 340. (Spring)

Theroux/*Four credits*

#### **BIO 480 SEMINAR IN LIFE SCIENCES**

An overview of a defined scientific topic (such as the process of cell division) will be presented, and then recently published articles on this topic will be discussed in detail. As part of the course requirements, each student will be asked to present one or more assigned journal articles to the class. The course is designed to increase the student's knowledge of an active area of scientific inquiry and to enhance the student's reading, data analysis, and oral presentation skills. Prerequisites: Seniors or second semester juniors who have completed BIO 160 and five additional biology and chemistry courses, and permission of instructor.

Staff/*Three credits*

#### **BIO 490–491 INDEPENDENT STUDY**

Directed study or experimental research. Prerequisites: Six courses in Biology and consent of instructor. The student is expected to have a G.P.A. of 3.0 to enroll. (Offered by arrangement)

Staff/*Three credits each semester*